U.S. DEPARTMENT OF ENERGY | Nuclear Energy

Nuclear Energy University Programs (NEUP) Fiscal Year (FY) 2015 Annual Planning Webinar

RC-06: Computational Methodologies to Support Design and Analysis of Sodium-cooled Fast Reactors

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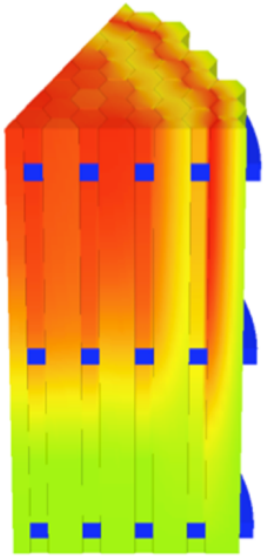
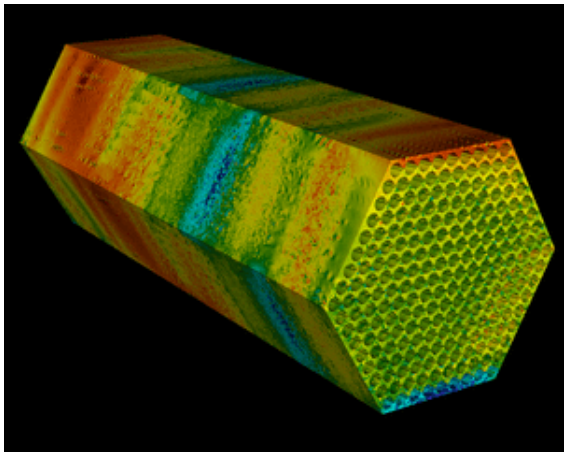
Methodologies Objectives

- **Develop Tools to Support Design and Analysis of Sodium-cooled Fast Reactors**
  - Neutronics / Thermal-Hydraulics / Structural Performance
  - Normal Operations and Postulated Accidents
- **Raise Technical Readiness**
- **Support Commercial Deployment**





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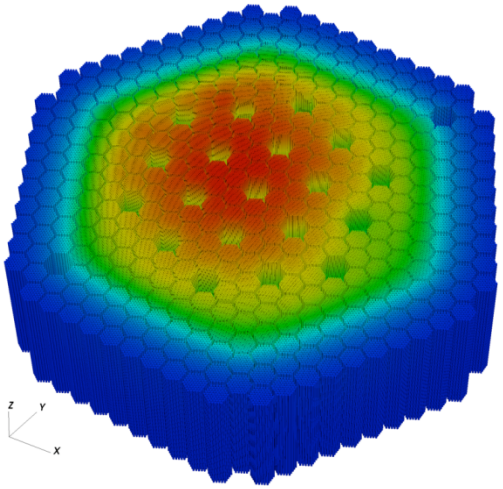
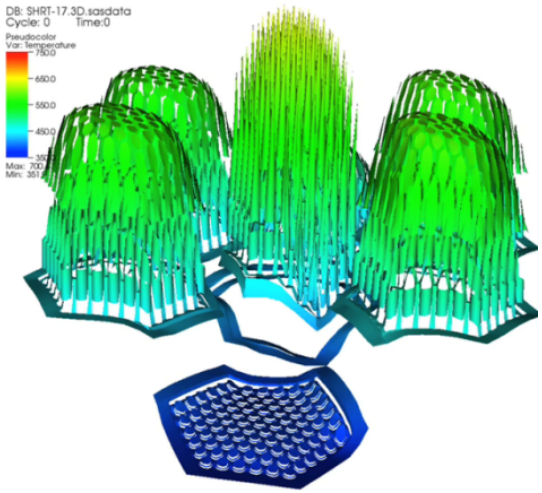
Methodologies Overview

- **Sodium-cooled Fast Reactor neutronics analysis methods**
  - Point kinetics
  - Neutron diffusion and transport
  - Characterization of complex reactivity feedback mechanisms to model inherent safety behavior of fast reactors
- **Thermal-hydraulics analysis methods for modeling very low Prandtl-number liquid metal flow and heat transfer**
  - Systems and safety analysis tools
  - Subchannel methods
  - Computational Fluid Dynamics (CFD) methods





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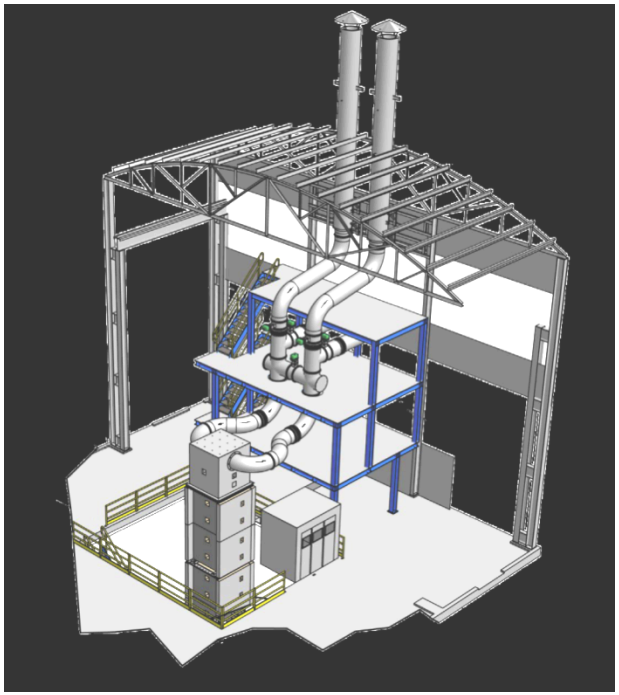
Current Activities

- **Ongoing Experimental Work**
  - Ex-vessel cooling at Argonne's Natural-circulation Shutdown Test Facility (NSTF)
  - Archiving past integral transient testing data from EBR-II, FFTF, and TREAT reactors to support code validation efforts
- **Code development activities**
  - Enhancement of SAS4A/SASSYS-1 systems and safety analysis code system
  - Incorporating sodium accident analysis capabilities of CONTAIN-LMR under MELCOR code to support containment design-basis assessments with respect to sodium fires



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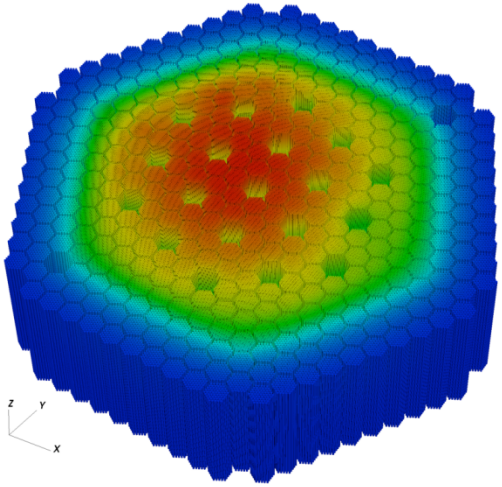
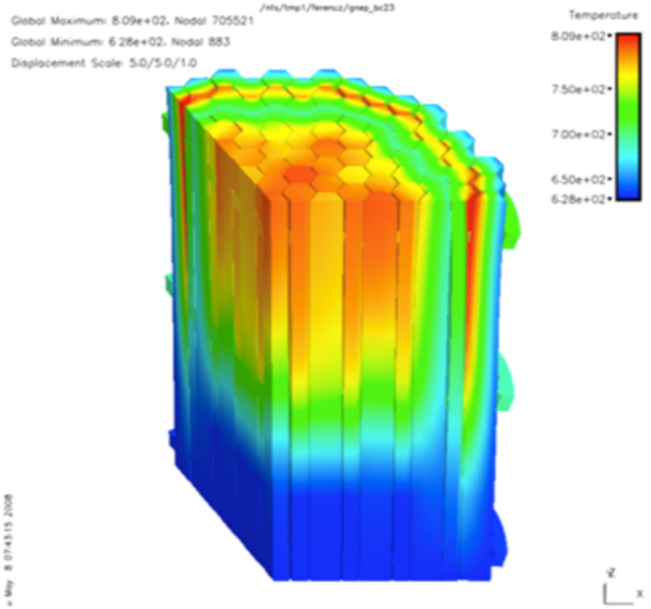
Specific Topics of Interest

Contributions to the development of advanced modules in the following areas:

- **Modeling pin-power reconstruction, temperature gradient, and reactivity feedback distributions within a SFR subassembly using transport-based flux solutions for evaluating:**
  - Steady-state thermal-hydraulic analysis
  - Fuel bowing and core radial expansion effects





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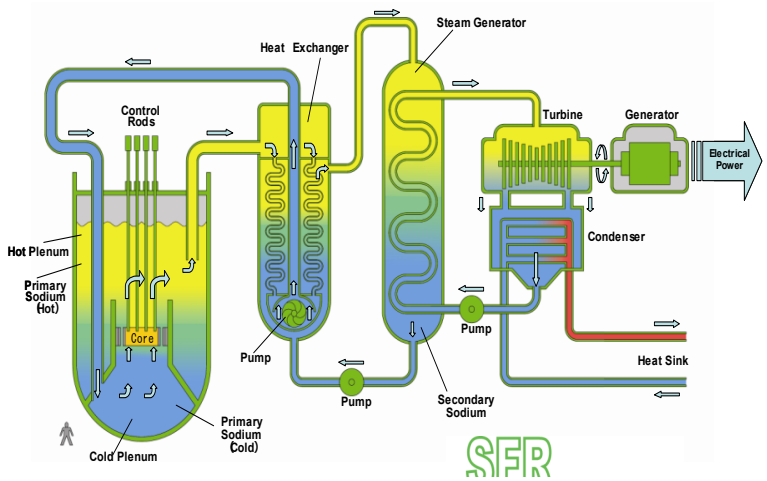
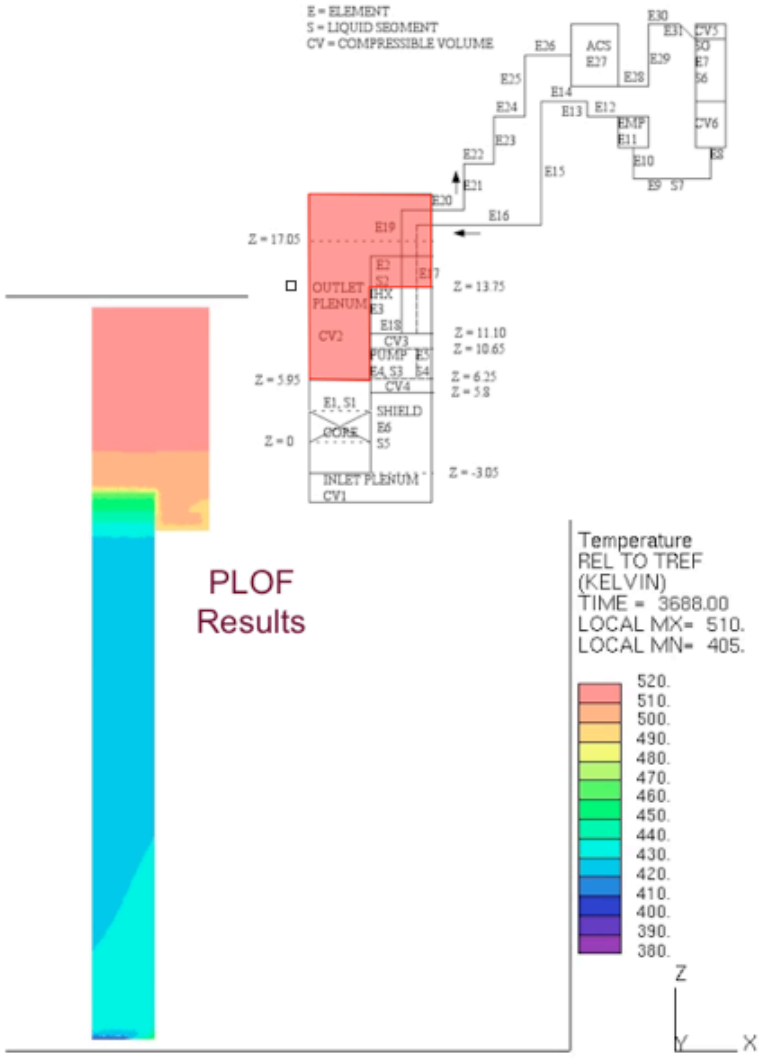
Specific Topics of Interest (Cont.)

- **Modeling the mixing and thermal-stratification in large volumes of a pool-type SFR (e.g., upper plena) following a scram including its influence on:**
  - **Natural circulation flow rates,**
  - **Decay heat removal.**





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Summary

- **Develop Tools to Support Design and Analysis of Sodium- cooled Fast Reactors**
  - Raise Technical Readiness
  - Support Commercial Deployment
- **Strong consideration given to enhancement, validation & verification, and use in uncertainty analyses of codes and analysis capabilities currently being developed under the ART program**
- **Specific topics of interest include:**
  - Modeling pin-power reconstruction, temperature gradient, and reactivity feedback distributions within a SFR subassembly to support thermal-hydraulic analysis and fuel bowing effect
  - Modeling post-scram mixing and thermal stratification to support decay heat removal in pool type SFR

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